Connecting the Dots Between NOAA's Hurricane Social Science Efforts:

Using Hurricane Supplemental Triangulated Findings to Guide Research, Development, and Operations

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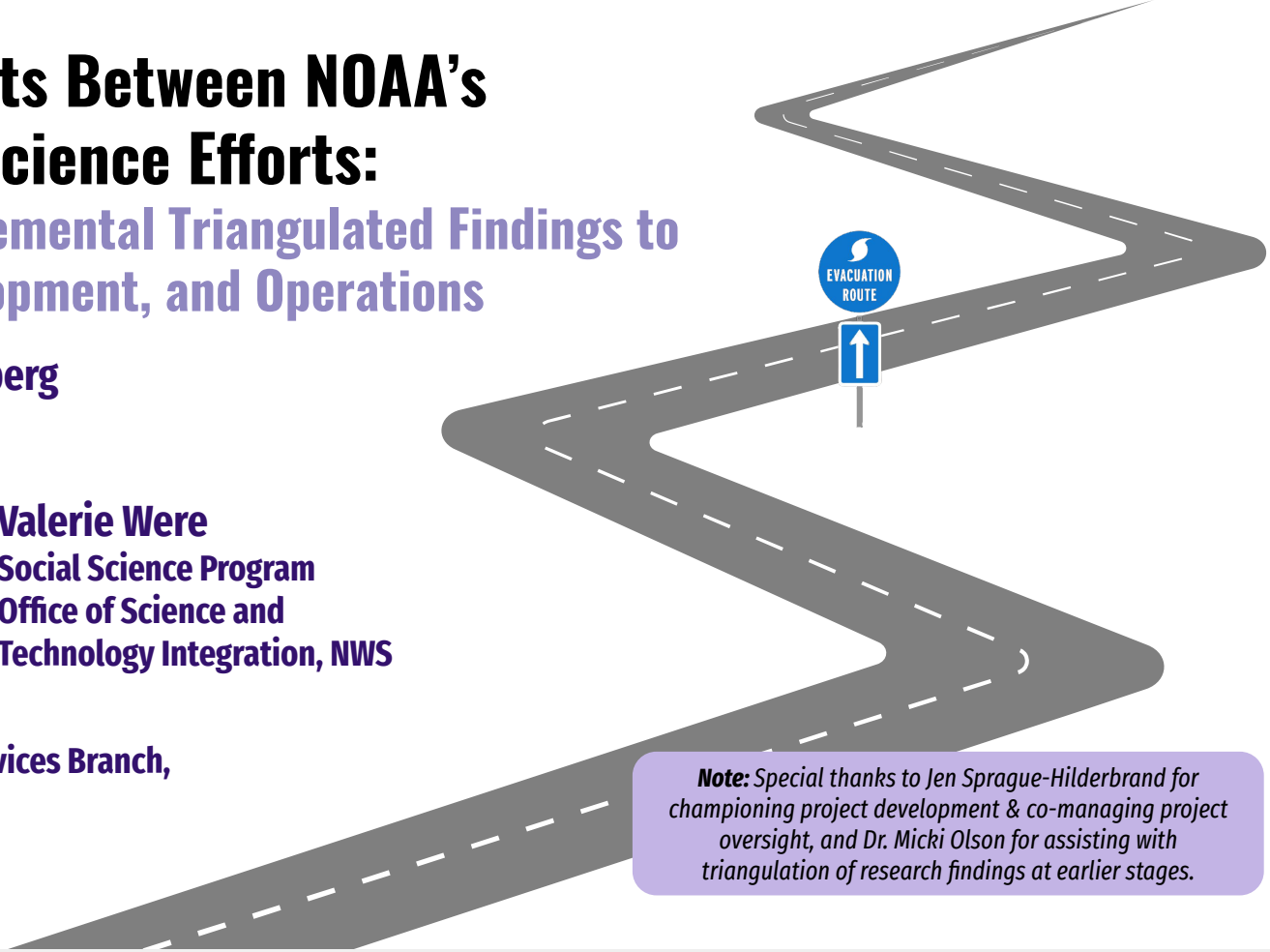
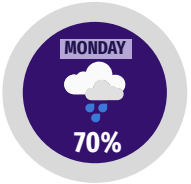


Note: *Special thanks to Jen Sprague-Hilderbrand for championing project development & co-managing project oversight, and Dr. Micki Olson for assisting with triangulation of research findings at earlier stages.*

There's a Chance for What? Assessing numeracy skills of forecasters, partners, and publics

Dr. Joe Ripberger (PI)



Set of 4 studies that mapped comprehension and communication of probabilistic information by surveying weather forecasters, emergency managers, and members of the public.

Minding the Gap: Modernizing the TC product suite by evaluating NWS partner info. needs

Drs. Rebecca Morss & Ann Bostrom (PIs)

Used semi-structured interviews and survey methods to understand how broadcast meteorologists and emergency managers currently use the tropical cyclone product suite.

Wait, the forecast changed? Assessing how publics consume/process changing TC forecasts

Drs. Julie Demuth, Rebecca Morss, Leysia Palen, & Gabrielle Wong-Parodi (PIs)

Deployed a longitudinal survey before, during, and after Hurricanes Laura and Marco (2020), Henri (2021), and Ian (2022) and analyzed Twitter data during Hurricane Harvey.

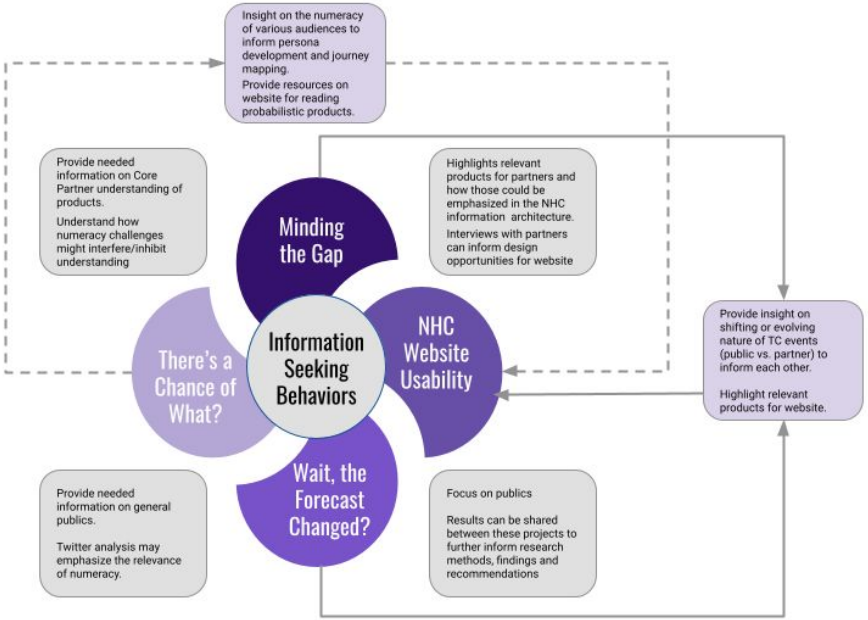
Optimizing TC information: An NHC web user experience study from a public perspective

Dr. Scott Miles and Dr. Robert Soden (PI)

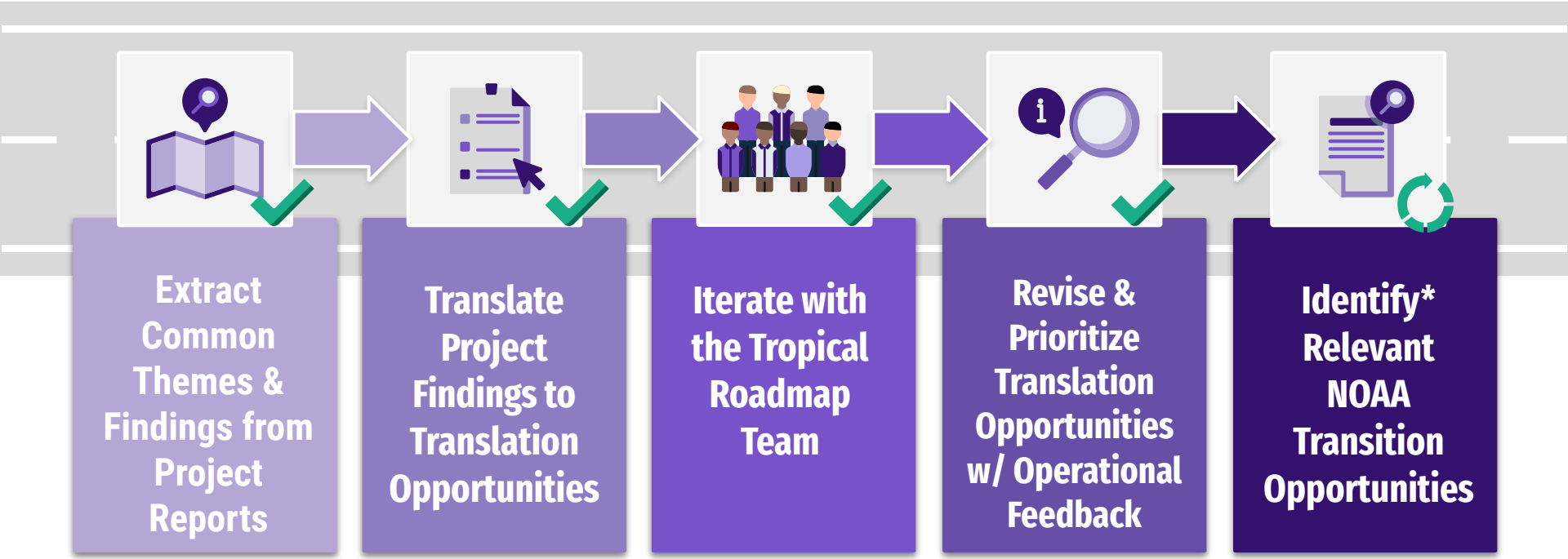
Used a variety of usability and user-centered design methodologies (e.g., interviews, heuristic analysis, card sorting, etc.) to identify four design opportunities for modernizing the NHC website.

What is Triangulation?

"Triangulation in research is the use of more than one approach to researching a question. The combination of findings from two or more rigorous approaches provides a more comprehensive picture of the results than either approach could do alone." *(Heale and Forbes 2013)*



The Social Science Triangulation & Translation Process



*When identifying NOAA transition opportunities, many different NOAA stakeholders are being consulted and iterated with to assess operational viability in order to put forward relevant and actionable recommendations.

Big Takeaway from Triangulation Efforts

Generally speaking, broadcast meteorologists, emergency managers, and members of the public find NOAA/NWS' tropical cyclone products and services ***useful and important.***

Big Themes & Takeaways from Triangulation Efforts

Identify ways to localize & personalize TC information

Improve the accessibility of TC products and services.

People search for different types of information during different phases of the lifecycle of a TC threat.

Timing information is critical for decision-making, thus the *timing* of when forecasts are issued is important too.

Uncertainty information is important to communicate, but it is not always communicated well.

Graphical TC products are important, but some need to improve their depiction of risk and/or uncertainty.

There is a misperception among forecasters & partners that the public does not understand uncertainty info.

There is a misperception that emergency managers are highly numerate like weather forecasters.

01

People use and benefit from probabilistic information when making decisions. **Providing short explanations** that describe how to interpret probability information with a graphic or product can **significantly improve their understanding.**

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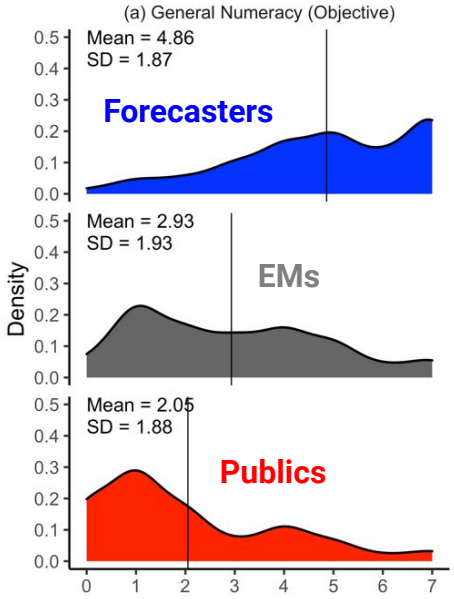
Probabilistic Information and Numeracy Takeaways

Hurricane Supplemental Findings



Set of 4 studies that mapped comprehension and communication of probabilistic information by surveying weather forecasters, emergency managers, and the public.

Numeracy Findings

EMs are generally more numerate than members of the public, but they look more like the public than forecasters.

Vague Messages

A majority of forecasters/EMs use vague words and phrases vs. precise numbers to explain probability information.

Strong Messages

Strong messages that include numeric information help the public correctly interpret complex probability information.

Adding Communication Assist Text (CATs) to Probabilistic Products

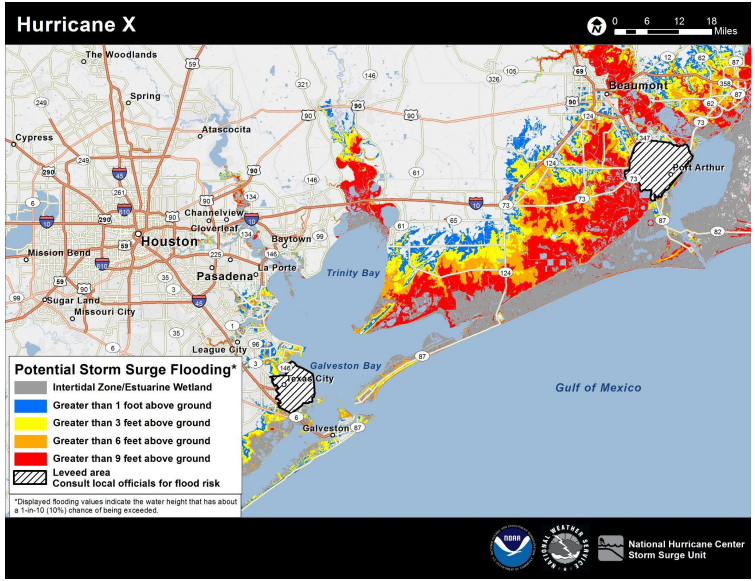
Short-Term Translation R&D Opportunity

Recommendation from Ripberger & Morss: *Forecasters should include a plain-language sentence or two explaining how to interpret probability information in graphics when sharing them with end users.*

Static CAT for Potential Storm Surge Flooding Map

This map shows a reasonable worst-case scenario of storm surge flooding that several locations along the coast should prepare for. There is approximately a 1-in-10 (10%) chance that storm surge flooding at any location could be higher than the values shown on the map.

Morss Finding



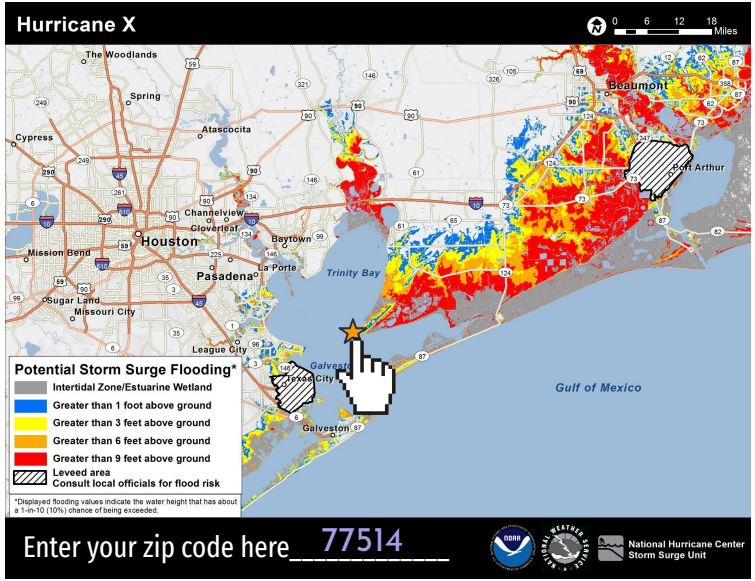
Adding Communication Assist Text (CATs) to Probabilistic Products

Long-Term Translation R&D Opportunity

Recommendation from Ripberger & Morss: *Forecasters should include a plain-language, locally tailored sentence or two explaining how to interpret probability information for their specific location.*

Dynamic CAT for Potential Storm Surge Flooding Map

This map shows a reasonable worst-case scenario of storm surge flooding of **greater than 6 feet above ground** that you should prepare for **in Smith Point, TX (77514)**. There is approximately a 1-in-10 (10%) chance that storm surge flooding in **Smith Point, TX** could be higher than the value shown on the map.



02

Different types of timing information (e.g., onset, cessation, and duration) are critical for decision making, and as a result, the timing of when forecasts, products, and data are released to partners is important too.

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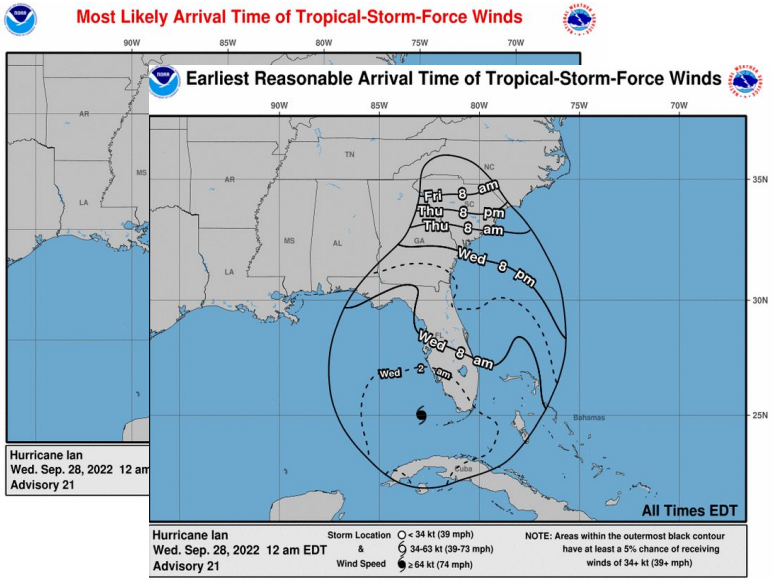
Partners Find Timing Information Very Important for Decision Making

Hurricane Supplemental Findings

Finding from Morss: *Many partners expressed interest in additional information about anticipated hazard timing information. Before expanding the Arrival Time product suite, some participants offered feedback.*



Broadcaster Feedback

The product is hard to edit on their devices they use or the data layer is not available. Some said the product provides too much information or is too difficult to understand.

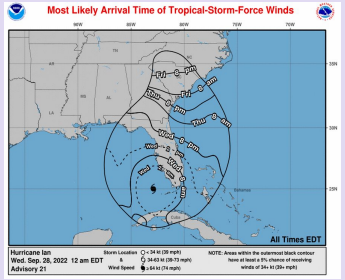
Emergency Manager Feedback

The product does not provide information specific enough to their area or takes up too much time to understand. Some said the product is commonly misunderstood or is difficult to explain to the public.

Partners Want More Onset, Cessation, and Duration Timing Information

Translation Opportunities

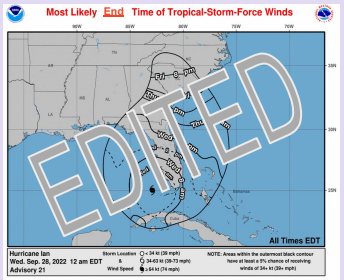
Onset



Arrival Time Graphic Suite

Currently supports evacuation decision making; need more partner feedback to consider expanding these products.

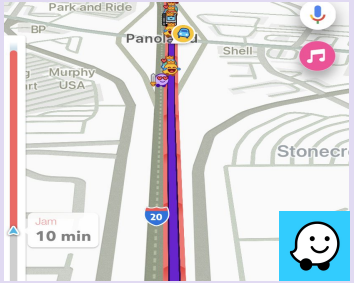
Cessation



Most Likely End Time Graphic?

Partners asked for more end time information to decide when to halt and resume preparation and emergency services. End time graphic?

Duration

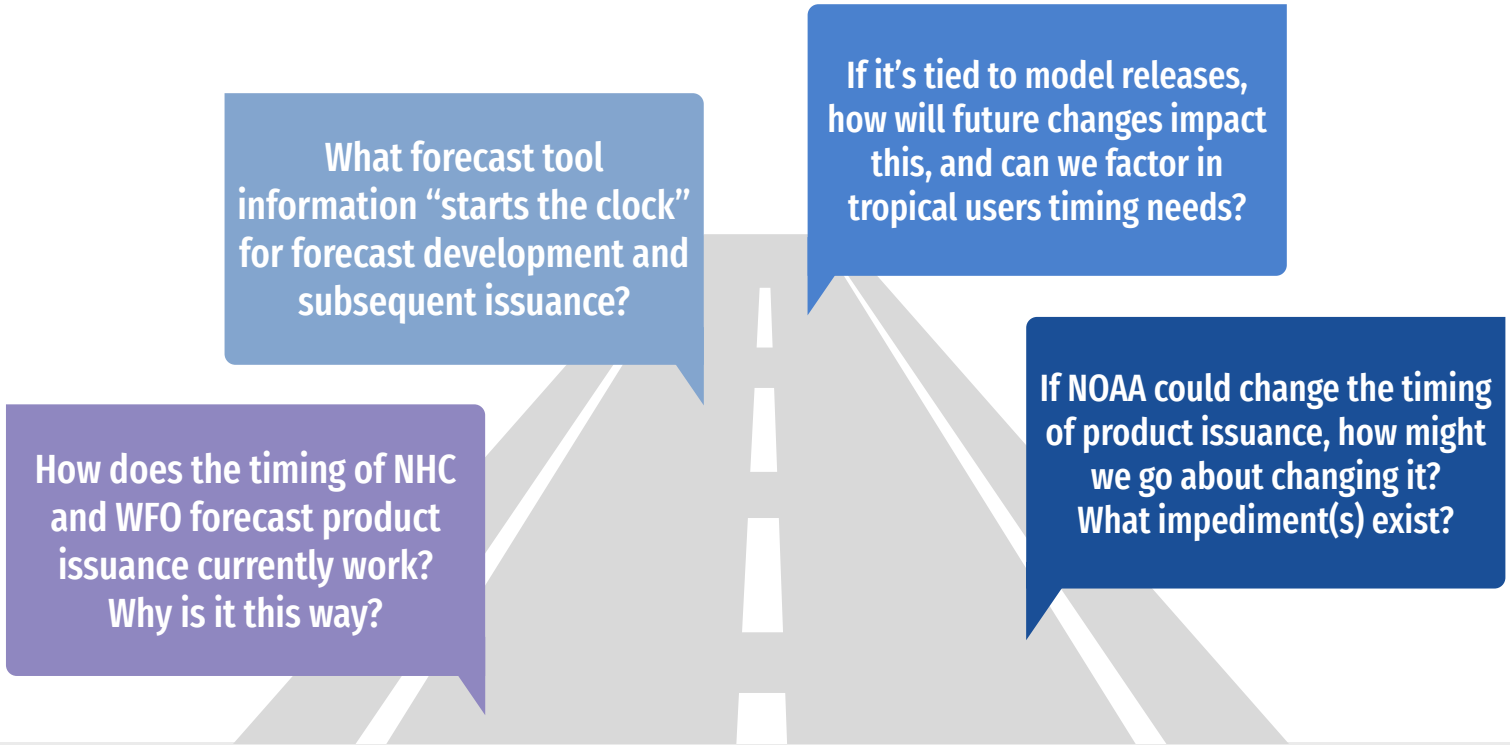


Duration Product Like Waze?

Can we use probabilistic information in a different way to provide duration information? Similar to the Waze traffic jam duration feature?

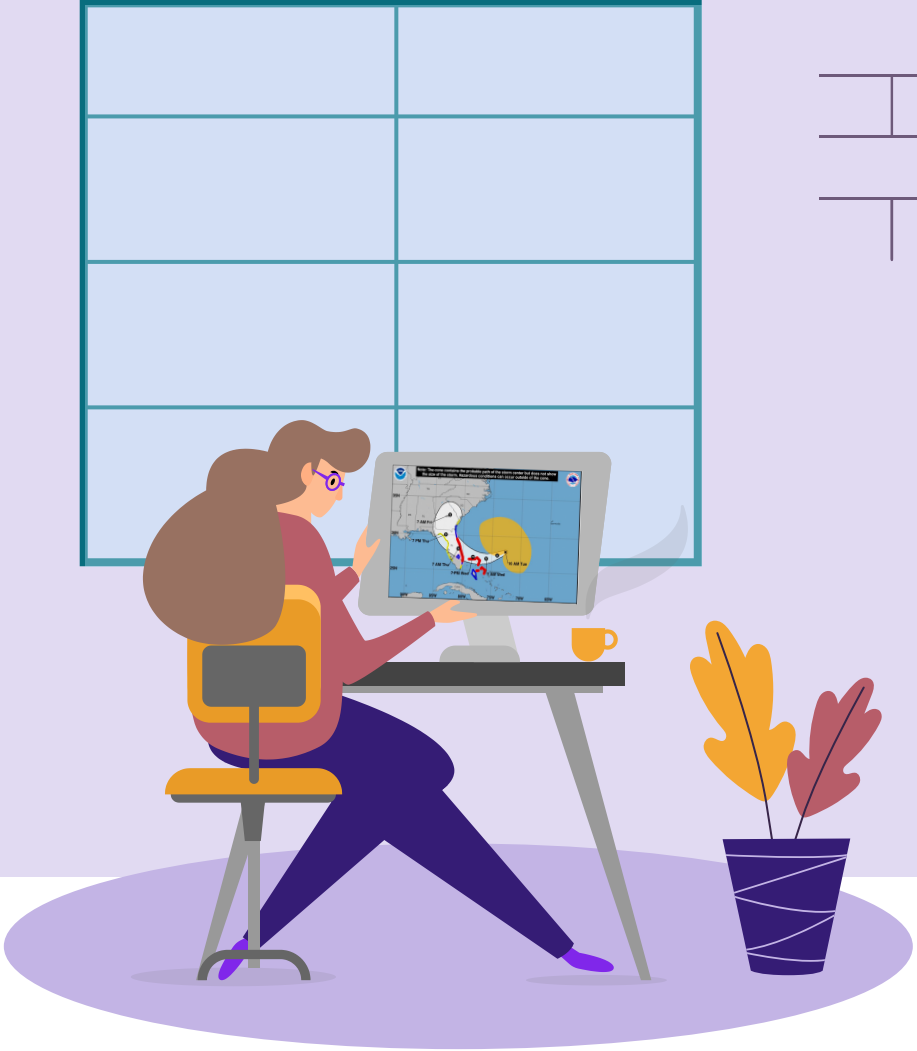
Questions to Consider About Forecast Product Issuance & Timing

Translation R&D Opportunities



03

At greater than five days of lead time, partners asked for more information about **tropical cyclone tracks and scenarios, forecast models, and forecast confidence or uncertainty.**



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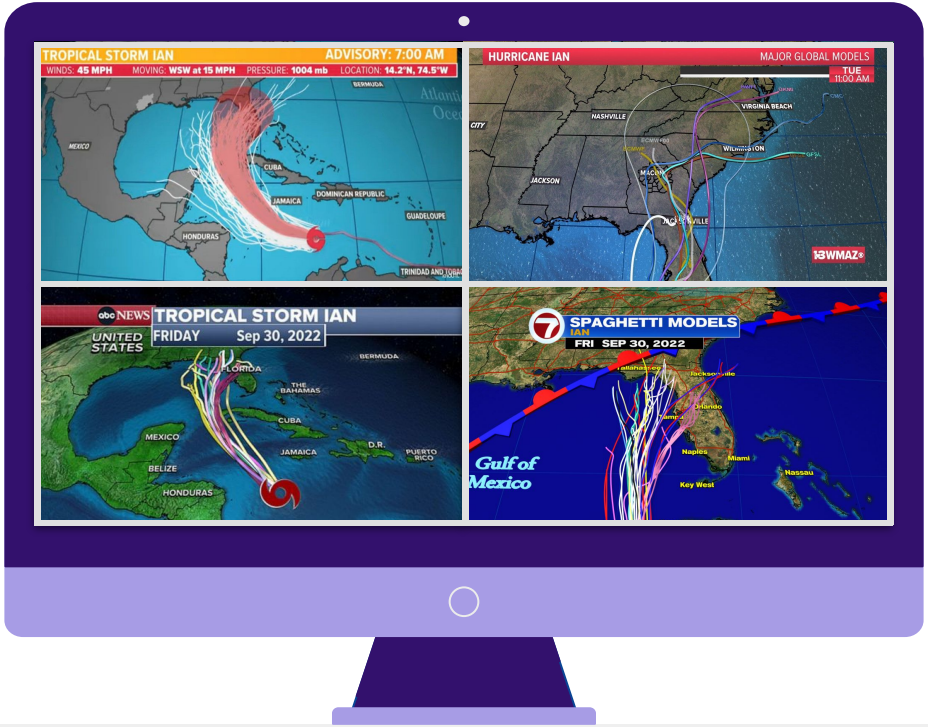
Partners Look to Other Sources for Information about TC Tracks and Threat Scenarios

Hurricane Supplemental Findings

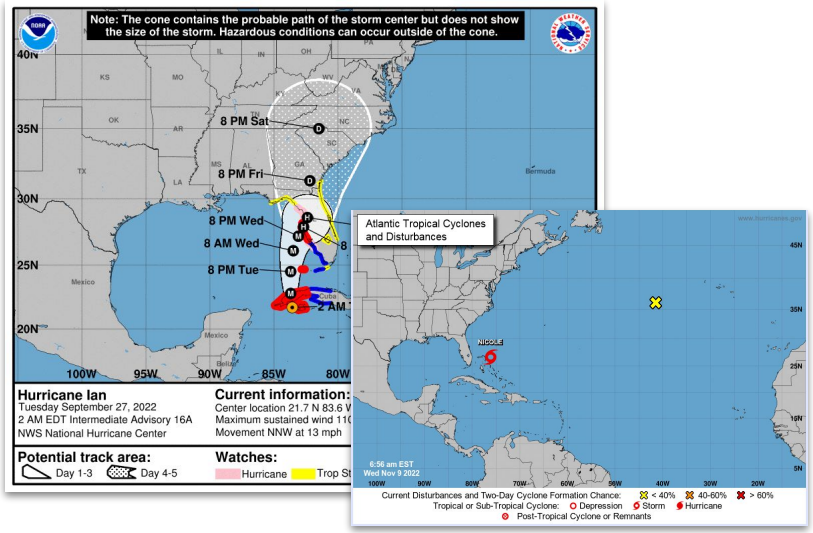
Finding from Morss: *In the absence of an official NWS forecast product, partners seek information about potential TC tracks at longer lead times from other sources such as looking at numerical model output.*

Finding from Morss: *The fact that NWS partners are seeking out unofficial TC track information at more than five days of lead time suggests that this is an important gap in the TC product suite.*



Adding Information About Possible Tracks and Scenarios Should Be a High-Priority *Translation R&D Opportunities*

Recommendation from Morss: *Develop a new graphical product or interactive service that complements the already-popular NHC Tropical Weather Outlook and Track Forecast Cone that leverages ensemble numerical model output to provide additional information about TC tracks and threat scenarios.*



What Could This New Graphical Product Do?

Depict multiple potential TC evolutions using curated model output, accompanied by forecaster annotation or interpretations.

Make the Cone graphic interactive or dynamic with pop up windows that provide explanations about what to expect at a local scale.

Dynamic CATs!

Summary & Main Takeaways

People Benefit from Probabilistic Information

Providing short explanations that describe how to interpret probability information with a graphic or product can significantly improve their understanding.

Timing Information is Critical for Decision-Making

Partners finding timing information very important for decision making, and as such, expressed interest in additional information about anticipated hazard timing information.

Partners Want TC Track & Scenario Information

In the absence of an official NWS forecast product that shows TC tracks or threat scenarios, partners look to other sources and to numerical model output for insights.

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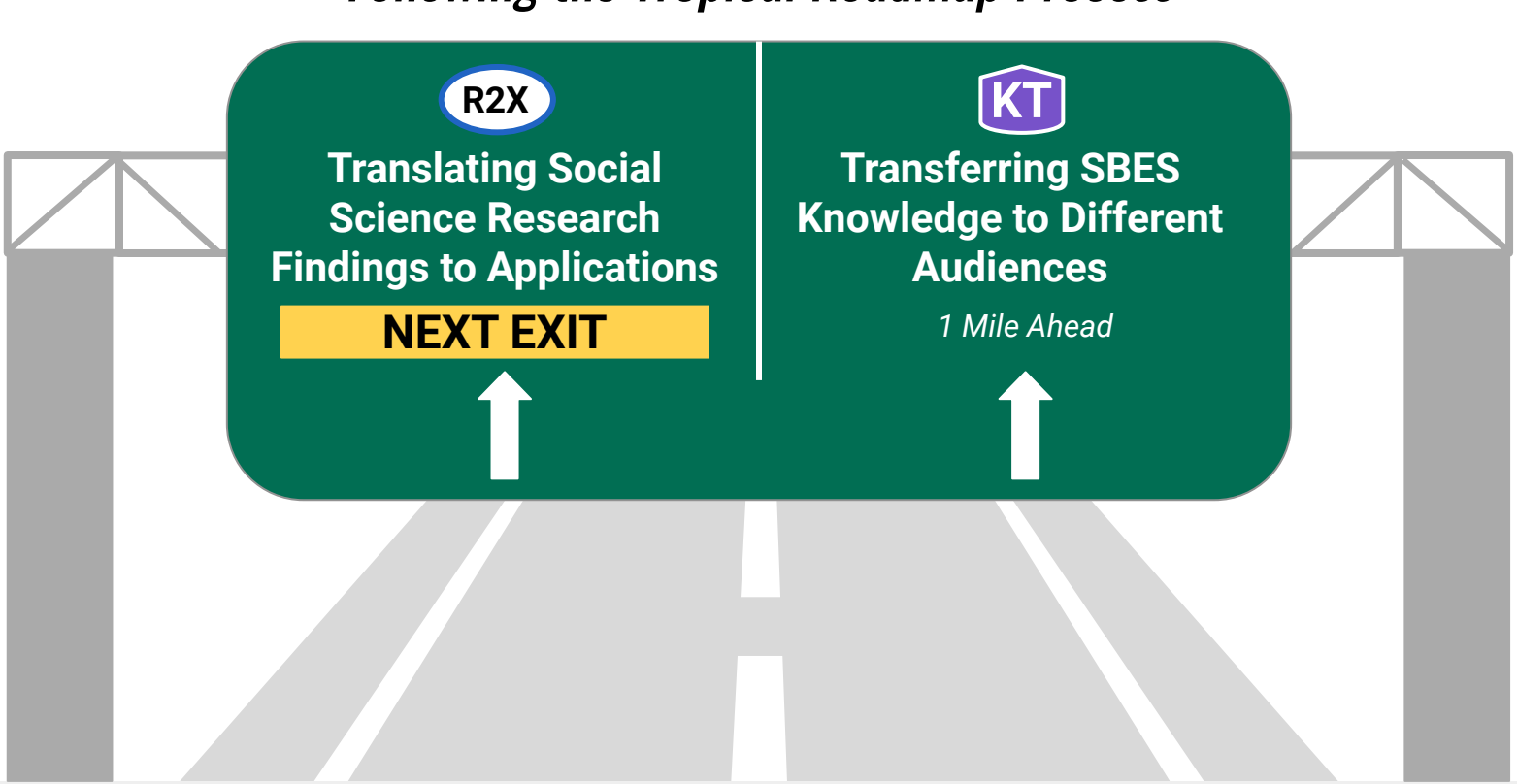
Next Steps - Translating Social Science Findings

Following the Tropical Roadmap Process



Questions?

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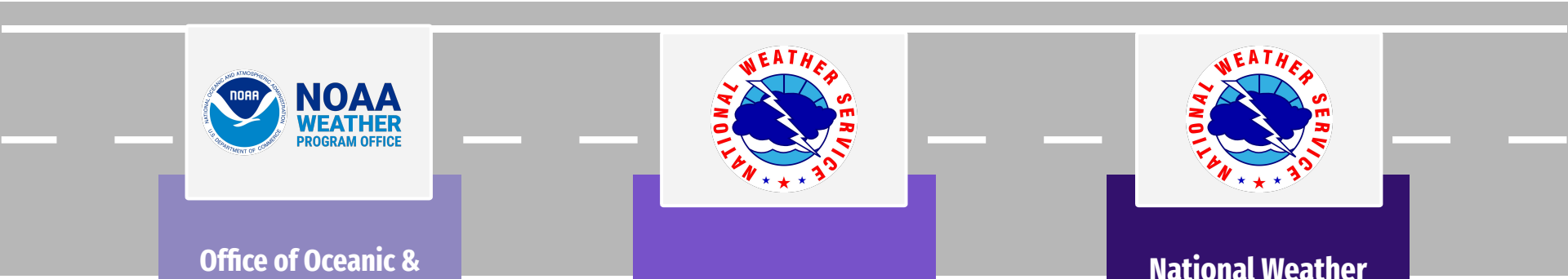

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Using SBES Longitudinal Data to Impact Real-Time Operations & Messaging:

A Long-Term Vision for the Weather Enterprise

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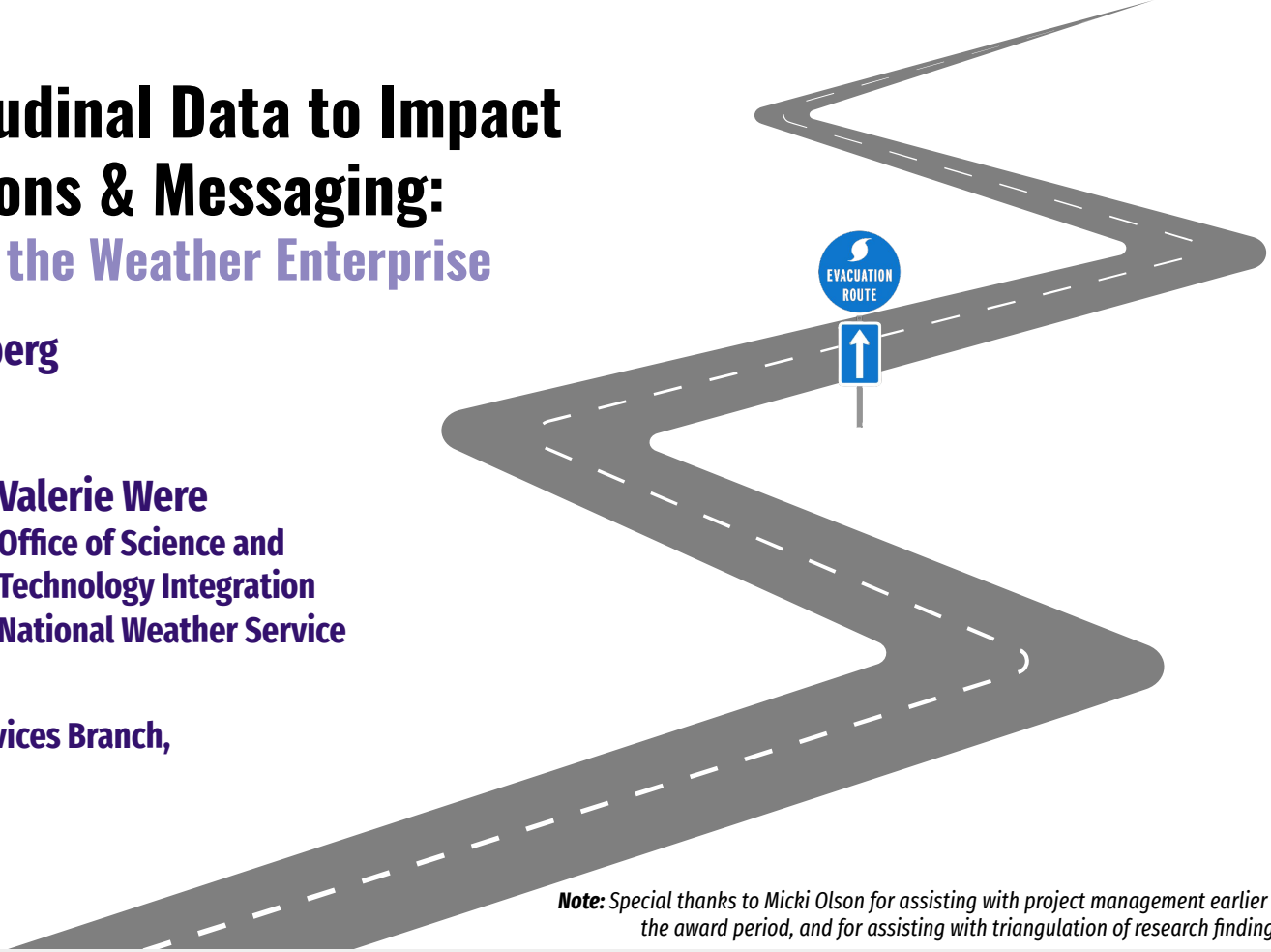

Note: *Special thanks to Micki Olson for assisting with project management earlier in the award period, and for assisting with triangulation of research findings.*

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04

Develop an operational center that could analyze longitudinal SBES data and provide **real-time societal insights to guide IDSS messaging** to partners and publics.

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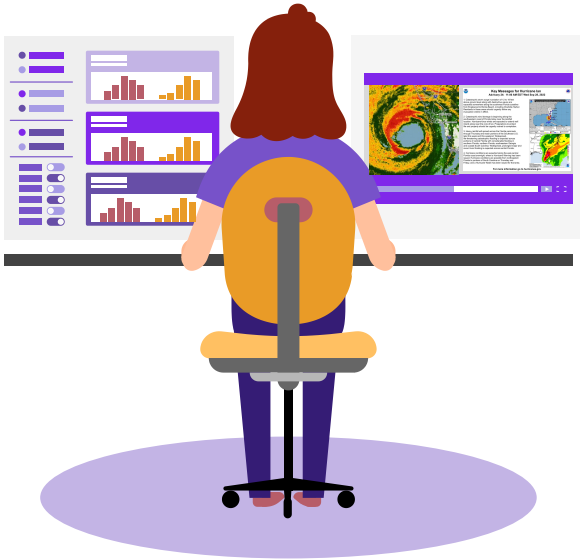
Using SBES Longitudinal Data to Impact Real-Time Operations and Messaging
Translation R&D Opportunities

Recommendation from Demuth: *A mechanism could be developed to analyze social observations in near real-time to identify critical misperceptions and/or lack of awareness about TC risks to impact messaging.*

Proposed Center for Real-Time Societal Insights (CRTSI)?

Staff social scientists could analyze real-time social science data and deliver insights to operations to identify critical misperceptions and guide real-time IDSS and messaging to address any identified public and/or partner misperceptions.

- **What physical science components would be needed to sustain this methodology in operations?**
- **How could it functionally be connected to physical observational data?**



Meteorological vs. Social Science Data Analog When a Real-World Hurricane Is Threatening the U.S. — A Cost Comparison

SBES Longitudinal Survey Data Collection Costs

- Laura and Marco Survey (2020) = $77K
- Henri Survey (2021) = $71K
- Ian Survey (2022) = **$95K**
  - Higher costs because they recruited more demographically diverse groups.

Hurricane Hunter Data Collection Costs for Ian

- Staffing ~$6K/hour, so 8-hour flight = $48K
- Dropsondes ~$500 each, 20 per flight = $10K
- 14 flight missions into Ian (Losurdo 2022) = **$812K**
- Plus cost of airplane and fuel

Analysis courtesy of Demuth et al. (2023)